On a New Species of Lepidopterous Insect. By G. R. Gray, F.L.S. & Z.S., etc.

Among the various novelties sent home during the voyages of H.M.SS. 'Rattlesnake' and 'Herald' by Mr. Macgillivray, is the splendid Butterfly now laid before the Society. It belongs to the great genus *Papilio* and to the subdivision *Ornithoptera*, and like the other known species of that group, its flight is very elevated; so much so, that it became necessary to employ powder and shot to secure the specimen; many shots have perforated the wings, and have rather damaged the specimen, but still not so as to entirely destroy the beauty of this remarkable butterfly. No lepidopterous insect of its magnitude has hitherto been known from the locality of this species; which, from the other insects contained in the same box, is supposed (as no memorandum was sent with it) to be either Solomon Islands, Aneiteum, New Hebrides, or the Fiji group,—at any rate from one of the islands in the South Pacific Ocean.

The general colour is glossy bronze-black, with the two outer rows of irregular-sized spots of pure white, while those at the base of the fore wings are rich king-yellow, but partly pure white outerly; the anterior margin of the secondary wings narrowly bordered with king-yellow.

The under surface like the upper; but the anterior margin of the secondary wings broadly bordered, and some of the spots tinged, with rich king-yellow. The head and thorax pure black; the body ochraceous yellow above, and black along the middle beneath.

It is a female. The male remains at present unknown, but one may suppose, by the usual brilliancy of the males of this group to which it belongs, that it is likely to prove a most beautiful insect, exhibiting some gorgeous combination of colour.

The name I propose for this splendid insect is *Papilio* (*Ornithoptera*) *Victoriæ*.

ROYAL SOCIETY.

Dec. 13, 1855.—Colonel Sabine, R.A., Treas. and V.P., in the Chair.

"On the Structure and Development of the *Cysticercus cellulosæ*, as found in the Pig." By George Rainey, Esq.

The *Cysticercus cellulosæ*, in its mature state, consists of two parts: one a small oval cyst, composed of a very thin membrane, rendered uneven on its external surface by minute rounded projections, and containing in its interior, granular matter, particles of oil, and a colourless fluid. This may be called its ventral portion. The other is folded inwards, occupying the centre of the cyst just described, but by pressure it may be made to protrude. This part is sometimes called the neck. Its length varies very much in different *Cysticerci*, depending upon their age. It is hollow, having strong membranous parietes, wrinkled transversely, and composed both of circular and longitudinal fibres. The cavity has no visible communication with that of the ventral portion. It contains a multitude of small oval laminated calcareous bodies, which, when acted upon by acids, effervesce briskly, and become partially dissolved, leaving only a small residue of animal matter. When the neck is protruded, the extremity farthest from the cyst is seen to present an enlargement, sometimes called the head, on the free surface of which there is a quadrangular area, occupied by four circular disks and a ring of hooklets. Each angle contains a disk, and the hooklets are placed in a circle around the centre of this space. The suctorial disks are traversed each by a passage taking rather a spiral course, and terminating in the cavity of the neck. The membrane composing a disk presents two orders of fibres, circular and radiating. The hooklets are generally twenty-six in number, thirteen long and as many short, arranged alternately a long and a short one. Each consists of a curved portion like a bird's claw, and a straight portion or handle; and at the junction of these two parts there are tubercles, two in the short hooklets, and only one in the long ones. The hooklets are crossed by two zones of circular fibres. They are also connected by radiating fibres, which occupy the spaces between each adjacent pair, like the interosseous muscles situated between the metacarpal bones and phalanges. The hooklets are disposed like radii, with their points turned outwards and the extremities of their handles inwards, which, not meeting, circumscribe a circular space whose centre corresponds to that of the quadrangular area before mentioned. At this part there is no perforation answering to an oral orifice, but here the membrane is simply depressed so as to present a conical hollow. By pressure upon the neck, this membrane can be made to protrude in the form of a tongue-like process, to which the handles of all the hooklets are connected, so that when this part in the living animal is made to move, the handles of the hooklets will be drawn in with it, and their points carried from the entozoon, and thus made to penetrate the part to which it attaches itself. These entozoa are chiefly found in the cellular intervals between the muscular fibres, contained in an adventitious cyst formed by the condensation of the surrounding tissues. No more than one entozoon is ever met with in one cyst.

Development of the Cysticercus cellulosæ.

The earliest appearance of the incipient stage of the *Cysticercus cellulosæ* is a fusiform collection of small cells and molecules in the substance of a primary muscular fasciculus, or immediately beneath its sarcolemma. These cells, in this condition of the entozoon, have only an imperfect or partial covering; however, they soon become completely enclosed in a well-defined membrane which is at first homogeneous, but which afterwards sends out short, slender, projecting fibres, resembling short hairs or cilia. These hair-like fibres, though resembling in some respects cilia, differ from them in being much less sharply defined and less pointed; however, for convenience sake, I shall speak of them as cilia. Their direction is remarkable. At either extremity of the fusiform animal they are reflected backwards at a very acute angle, like the barbs of a feather, their direction being of course opposite at the two ends. They become less and less inclined as they approach the middle of the body, where they stand out at right angles to the surface. The apparatus of cilia-like processes above described is evidently designed to give to the entozoon, whilst in this stage of its existence, the power of penetrating between the ultimate muscular fibrillæ, and thus to enable it to force its way from the interior of a primary fasciculus into the spaces between the muscular fibres. This will be the effect of the friction of the fibrillæ against the cilia, which will allow of motion in one direction only. And as its two ends must move in opposite directions, the cilia will also serve to aid the entozoon in its development longitudinally. That such is their office will be apparent on examining a sufficient number of specimens; in some of which the primary fasciculi will be seen to have been completely split up by these animals. But the correctness of this inference is more strikingly proved by the influence which the size and arrangement of the primary bundles of muscular fibres have upon the form and dimensions of the entozoa. Thus in the muscular parietes of the heart, where the primary fasciculi are smaller, and, from their frequent interlacing, shorter than in other parts, the *Cysticerci* are, in this stage of their development, also very short and of a different form to those found in other muscles, composed of striped fibre, although in other respects perfectly similar; and, when completely formed, those taken from the heart cannot be distinguished from those formed in other muscles. The cells which have been alluded to as forming the principal part of the *Cysticercus* thus far developed, and contained in the investment first described, are all of the same character, differing only in their form and size, according to their age and situation. Those situated about the centre, and forming the chief part of its bulk, are collected together into rounded masses, giving to many of the animalcules an obscurely annulose appearance. They are of an elliptical, or rather reniform figure. This form, however, is not essential to these cells, but merely results from the circular shape of the masses into which they enter, the convexity of each cell being a part of the outline of its respective mass. These cells contain minute granules, or rather molecules, which are variously disposed in different cells, so as to present a variety of appearances, such as circular spaces, which might be mistaken for nuclei, but which seem rather to be produced by a deficiency of the cell's contents at these parts, than by any distinct nucleus. The mode of formation of these cells must be examined in the growing parts of the animal, and for this purpose its extreme ends are best adapted. When one of these ends is about to have an addition made to its length, the investing membrane at this part becomes at first very thin, and then disappears. A clear space is next seen, having in some specimens the form of the part which is about to be added to the extremity of the entozoon; in others it has no defined limit. This space contains, in some cases, nothing but extremely minute molecules, of different shapes; in others, these molecules are mixed with granules of various sizes, which have every appearance of having been produced by the coalescence of the molecules; and lastly, with these molecules and granules, there are in other examples very distinct globular cells, of a bright aspect, looking more like nuclei than perfect cells; these soon become flattened oval, and ultimately take the elliptical form before described. All the time these changes are taking place in the molecules and cells, the membrane has been in progress of formation, so that when the molecules have disappeared, and their place has become occupied by perfect cells, the end of the animal is completed. The cilia are soon afterwards added. The lateral growth of these animals takes place in the same manner: the first indication is a separation of the cilia, which, it must be observed, are larger at the sides of an entozoon than at the extreme ends; and then a thinning of the membrane supporting them; and, lastly, the formation of globular cells, as before noticed. After the animals have become of a considerable size, and forced their way from the interior of the primary fasciculi into the cellular spaces between the larger muscular fibres, they still continue to grow, especially in breadth; but they lose their cilia, and gradually acquire those parts which have been described as belonging to the neck. The first evidence of this addition is the appearance of inversion of the middle part of the cyst, forming a small hollow, the sides of which look as if thrown into folds containing granular matter, and the bottom presents a circular space in which are granular particles of various forms and sizes, but those in the centre are darker than the rest. It is from these particles that the suctorial disks, the hooklets, and the first of the laminated bodies are about to be formed, but as yet none of these parts are recognizable. At a stage a little more advanced, this apparent inversion of the cyst has increased, the neck has become longer, and the appearance of disks, hooklets, and laminated bodies is sufficiently distinct to be perfectly recognizable. The process of development is particularly apparent in the hooklets, and perhaps there is no other instance of the growth of an animal tissue which presents such facilities for the examination of the manner in which it is effected. First, because the part of the entozoon on which these organs are formed, is sufficiently transparent to admit of examination by the highest magnifying powers without any previous dissection. Secondly, because the material of which they are composed is so characteristic, and so dissimilar to the surrounding parts, that it can be detected in the minutest possible quantities. And, thirdly, as only a few of these hooklets are in progress of development at one time, and as these are in all stages of formation, every step in the progress of their growth can be traced from the merest molecule to a perfect hooklet. This is important in reference to the general theory of development, as it furnishes an example of the formation of a complete set of organs, on a plan more simple, and at variance with the cell-theory of Schwann and others. Before one of these hooklets takes on a recognizable form, it exists as a group of exceedingly refractive particles, all apparently of the same composition, and of a more or less globular form, but of very different sizes, some being so minute as scarcely to be visible by one-eighth of an inch lens, others being almost as large as the handle of a perfect hooklet, while the rest are of all dimensions between these extremes. The next condition of a hooklet is the apparent fusion or coalescence of some of these particles into the hooked part of the organ. Then the handle and tubercles are added, these having been previously formed by the fusion of the smaller particles, and these latter by the coalescence of the minutest and the minuter ones. Before the several parts are perfectly consolidated, their points of junction can be distinguished, and in other groups the fragments corresponding to those recently united can be recognized. Directly a hooklet is found, it is of its full dimension; and some of its parts are even larger and more clumsy-looking than in older hooklets. The substance of the particles entering into these organs, after they are once formed, undergoes no change in its microscopical characters, but is the same after as before their union. It is impossible to single out any one particle from the rest, which can be taken for the nucleus of a cell, or for what physiologists would call a nucleated cell; and thus there is nothing which indicates that these organs have been formed by transformation of previously existing cells, but, on the contrary, there is every appearance that their formation is due to the simple coalescence of homogeneous molecules.

Up to the present point, the facts which I have stated are so obvious, that their accuracy will, I think, not be questioned; also the interpretation of them is not only that which appears to me the most natural, but is almost self-evident. There remain, however, some considerations of a more theoretical kind, though not of less importance. It will be asked, how the entozoon, in its earliest condition, such as I have described it, finds access to the interior of a primary fasciculus. Before attempting to answer this question, I must observe that my description commences from a condition of this entozoon so complete, that no one, on examining it in this state with the microscope, will deny its perfect similarity to those of the higher form. But there are other links in the chain which I must now consider, and which so far have been omitted only because I wished to keep that which is certain distinct from that which is probable. Before the cells and molecules already described accumulate in sufficient quantity to present the undoubted character above mentioned, they are found aggregated in smaller groups, and even occurring individually in all the primary fasciculi of the diseased muscle; their quantity, and the size and form of these groups, present the greatest possible irregularity in the different fasciculi. In some the molecular deposit looks like an early stage of fatty degeneration, but it has characters very different; one is the shape of the molecules, which resemble in all respects those in the growing ends of an entozoon; and another is, their situation, which seems to be between the primary fibrillæ, tending to separate them longitudinally; however that may be, it is an abnormal condition, and always coexistent with the higher forms of the *Cysticercus*; and as the entozoon, as I have first described it, could not possibly have taken on that form all at once, these groups of molecules must therefore be looked upon as its antecedent stage, or as portions of *Cysticerci* in progress of development. But I also find in the specimens of muscle infested with these entozoa, many of the capillaries and smaller blood-vessels filled with organic molecules, which, so far as I am able to judge from the comparison of such extremely minute bodies, seem to resemble those molecules which are found in the primary fasciculi. The vessels filled with these molecules have their coats so thin as to be inappreciable, and some of the capillaries appear to be partially destroyed, and their molecular contents diffused among the sarcous elements. As this is an abnormal condition of the contents of these vessels, as well as of their coats, and, so far as my experience goes, is not found excepting in conjunction with the earliest stages of the *Cysticerci*, I am inclined to believe that the molecules in question are the same as those in the primary fasciculi, and that it is by their coalescence in these fasciculi that the formation-cells of the *Cysticerci* are formed.

Addendum, Dec. 6.—After an entozoon has left the interior of a primary fasciculus, and arrived at the space between the muscular fibres, it loses its ciliated investment, and increases in breadth. Its margin now seems to be formed entirely by the convexities of the globular masses of cells of which its body appears to be made up, causing it to present a crenate form similar to that of the ventral portion of the perfect animalcule, with this difference only, that these cells are compressed. The next change which is visible is the formation of folds, which become more perceptible as the animal increases in breadth, and which remain in the perfect entozoon so long as it is confined to a small space, but disappear when it gets to the space between the surface of a muscle and the fascia covering it. The unfolding in this last situation seems to be produced by the imbibition of fluid, and the consequent distension of the ventral part. These more advanced stages of the worm-form are best found in those specimens of diseased muscle in which the perfectly developed *Cysticerci* abound. Their number in proportion to that of the perfect animalcules varies considerably in different specimens.

I have always succeeded in finding some of those of the worm-form along with the perfectly developed ones; and in some cases there are as many of one kind as the other. After they have acquired a certain breadth—about one-twelfth, or the one-eighth of an inch,—the central part of the cyst appears to be drawn inwards, forming a hollow; at the bottom of which, the granular material is deposited from which the suckers, hooklets, and calcareous granules are formed, as above described.